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ABSTRACT

Over the past few years, video technology has been used to assist film directors after they have shot a scene, to control costs, and to create special effects, especially computer assisted graphics. At present, a computer based editing system called "Film 5" combines computer technology and video tape with film to save as much as 50% of the cost of conventional film editing processes. Filmmaker George Lucas has a group working to provide future services to filmmakers in the areas of a database for film production, a digital sound process, computer graphics, and video editing. Unlike Lucas, filmmaker Francis Ford Coppola stresses the ways technological efficiency can encourage human and creative processes in filmmaking. His "electronic cinema" concept uses information processing systems to blend the currently separate processes of preproduction, production, and postproduction. Besides their use in generating more sophisticated computer graphics in such films as "Tron," computerized video assisted production techniques currently under development will soon revolutionize the cinema. (JL)

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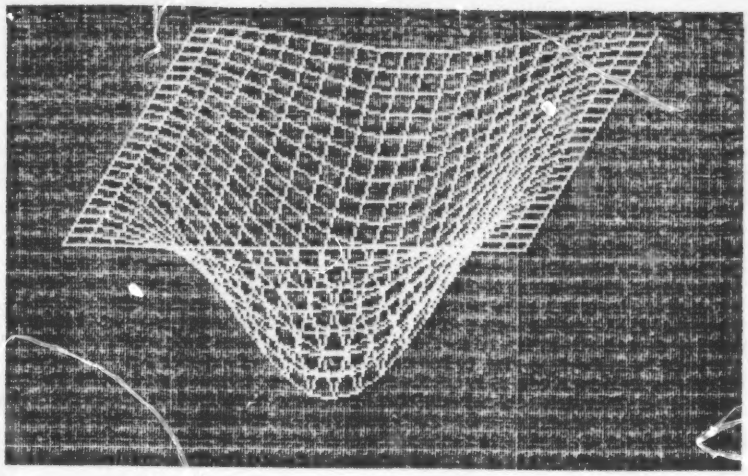

THE NEW FILM TECHNOLOGIES: COMPUTERIZED VIDEO-ASSISTED FILM PRODUCTION

Presented at

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THE NEW FILM TECHNOLOGIES: COMPUTERIZED VIDEO-ASSISTED FILM PRODUCTION

At the present time, the world is in a curious transition. The reason: the electronic revolution is here. What used to be a large, cumbersome machine, taking up at least one large room for business and scientific applications, has now been reduced to something the size of a pinhead.[1] It is controlling not only accounts receivable and space shuttle landings, but everything from making the family car more fuel efficient to entertaining youngsters by generating cataclysmic games on a conventional television set.

The young seem quite adept at dealing with the quick pace of this hot-wired revolution, but what really has me worried is the "analog generation"--we older folks trying to keep up with it all. If you haven't gotten past the banana on Ms. PacMan, or don't know a bit from a byte much less a pixel from a pixie, then you're in serious trouble. If you are a filmmaker, you might consider retiring early, bronzing your editing gloves, or joining the revolution as filmmakers are now doing. Welcome to the digital age!

The introduction of video in film production was a slow, modest one. At first, miniature television cameras were mounted in the viewfinders of motion picture cameras so that scenes could be viewed and checked for problems after the shot was filmed. This was known in the business as "video assist." It was most useful,

and still is, when the director also happened to be cast in the starring role. For instance, Clint Eastwood is reported to have used this technique in films in which he starred and also directed.

An interesting experiment worth noting in the early seventies was the video taped production of *Oh! Calcutta*. This video production was kinescoped to 35mm color film for theatrical release; however, the picture quality was poor. Video scan lines were evident as was an occasional video "glitch." It was clear that the current NTSC video standard of 525 interlaced scan lines was not enough resolution to produce a quality theatrical film image.

As film costs kept steadily rising, especially in the area of special effects, more emphasis was placed on electronic media to produce the same results at less cost. For example, the NBC television series *The Invisible Man* (1975-1976) employed a customized high definition video and motion control system for chromakey matte shots normally achieved in film by the complicated and more expensive blue-screen traveling matte system. These video matte effects were kinescoped to 35mm color film and intercut with conventionally filmed sequences in the show. Video composite matte effects could not only be produced more quickly and cheaply, but also with immediate results. It was soon realized that video could take the guess work out of composite shots where subject positioning, lighting and perspective were extremely critical.

Another area where the video image gained early ground in filmmaking was in graphic effects, either generated and/or assisted by a computer.

Computer-assisted graphics were being experimented with by independent filmmakers, like John Whitney, as early as 1960. Whitney founded Motion Graphics, Inc. that year, creating graphics for film and television utilizing his home-brewed analog computer for specialized animation incorporating typography and concrete design.[2] Thus, cybernetic art was born. With the help of grants from IBM, Whitney continued his work, finally producing his computer generated film, *Permutations,* with the help of a digital computer.[3] These early experiments were just the beginning of computerized mediamaking.

As television slowly gained ground within the film industry, the digital computer was slowly overtaking television. One of the first advances in this area was the character generator which replaced art cards. The next major advance was the time-base corrector capable of stabilizing and enhancing the video signal from helical scanned formats, such as the 3/4" U-Matic cassette. The result was a major shift from film news to portable electronic news gathering.

Currently, we are besieged by computer-generated video graphics. One example is the electronic weather map, which animates the Jet Stream, flashes frontal systems and indicates tropical depressions in vibrant colors. Computer-based special effects generators are capable of squeezing, twisting, twirling and dancing the image at varying speeds and perspectives. The application of computer-based television graphics is only limited by the imagination. The future promises high definition television systems with digital transmission, wide-screen dimensions and a

picture resolution equal to that of 35mm color film.

It was only a matter of time before the three technologies, born of separate disciplines, would eventually form an integrated triad. By combining computer technology and video tape with film, the medium is taking on new dimensions and in addition, saving the filmmaker time and money. In an *Industrial and Educational Television* magazine interview, Art Schneider, supervising editor at Consolidated Film Industries in California, explains how he developed a computer based editing system called "Film 5," which stands for "film interface video editing."[4]

The actual process is quite simple. The film negative is transferred to video tape with a SMPTE time code on the cue track. The time code is a set of numbers assigned to every film frame during the transfer. During the editing session, scenes are called up by the editor using the computer which locates the scenes on video tape. The edited sequence can be previewed before the actual edit takes place. As shots build into scenes and scenes build into sequences, the computer systematically keeps track of the editor's assembly to the exact frame and stores it in memory.

According to Schneider, filmmakers can "manipulate it, change it, modify it in any way, shape or form and as often as necessary until they achieve the final product."[5] The system can then generate a set of corresponding edge numbers so that the negative can be conformed exactly to the edited video cassette eliminating the need for a film workprint. The time saved with the computerized video editing can as high as 50 percent over the conventional film editing process.[6]

In addition, if the end product does not have to be film, a professional, color corrected video tape master can be assembled. The computer simply recalls the "editing session" with the editor from memory and begins to assemble the scenes on a professional VTR machine producing an edited master. The result is a broadcast quality video tape of the program. This was done for a recent episode of the *Greatest American Hero* when the production fell behind schedule with no time to edit the show in the conventional manner.[7]

Integrated video disk systems are being developed which will store unedited film transfers or video scenes.[8] Using computer technology, time codes and an interactive database containing the corresponding scene and take numbers, it will be possible to preview extended sequences in real time before a final master is assembled.

Two well known filmmakers who are currently investigating and experimenting with these new technologies are George Lucas of *Star Wars* fame and Francis Ford Coppola. Their approach, however, to the electronic revolution is rather different.

Lucas, for example, has assembled a computer development group consisting of 35 staff members under the direction of Ed Catmull.[9] The goal of the group is to "maximize the creative control of the filmmaker over the most complex production processes."[10] The group is responsible for creating "tools" of the future in four major areas: 1) a database system designed for film production; 2) a digital sound processor; 3) computer graphics; and 4) video

editing.

This research was prompted by Lucas's view that much of the equipment and techniques used in conventional filmmaking are "significantly behind the times."[11] Lucas's view differs from Coppola's in that these "tools" under development are not meant to solve immediate production problems but are seen as future services to be made available to filmmakers.

Coppola's view is more immediate and embraces his idealistic concept of "electronic cinema," which is discussed at length in an article in the August 1982 issue of *American Cinematographer.* According to this article, the ultimate goal of Coppola's vision "is to enable the production of more varied or personal films by reducing the time and money and risk involved in making them."[12] Although Coppola did not accomplish this with *One From The Heart* (1982)--since the development of a prototype system is rarely cost effective in the short term--he did produce his most recent film, *The Outsiders* (1983), within a 7-week shooting schedule and drastically reduced the post-production time.[13]

Coppola claims his system enables him to concentrate on the human and creative processes of making a film. By increasing efficiency without compromising quality, Coppola envisions a wider range of films than tried and true Hollywood formulas. It is this freedom which "electronic cinema" promises to make accessible.

Although Lucas's team is developing a database specifically for film production, the extent of its use during a film project is not as well publicized. Coppola, on the other hand, sees the computer database as the core by which the entire production

becomes centralized and unified. He uses the Xerox Star computer to carry out highly sophisticated information processing which will eventually incorporate all phases of production.[14]

The information processing system not only stores correspondence for the entire studio, but Coppola's ideas and thoughts as well. These ideas, which can be sorted and accessed in nanoseconds, can be expanded and developed using the system's word processing program. As of last summer, Coppola indicated that he had over twenty different scripts stored in the machine at different stages of development.[15]

After a script is completed, it can then broken down and analysed in a variety of ways. Coppola envisions a variety of computer programs that will eventually check a script for continuity, estimate production budgets and even analyze the script for plot/theme problems. A computer program could be written that would calculate the entire production's schedule based on script and location considerations. In this way, any revisions or changes made would cause the computer to make the appropriate adjustments in addition to notifying each department of the updated schedule.

Coppola is currently using telecommunications to transmit script notes and revisions from his shooting location to his editing facilities in California. The computer transmits this and other information over phone lines to computer monitors located in Zoetrope's editing rooms. He also uses an "electronic blackboard" on location which transmits everything he writes or draws back to the studio where it is displayed on CRT monitors.

The concept of "electronic cinema" is a blending and

overlapping of pre-production, production and post-production, which is currently seen as three distinct operational divisions.[16] This merging of the three operands of filmmaking allows the filmmaker to work faster, considerably reducing production time.

Once high definition television becomes a reality, it will complete the missing link in Coppola's "electronic cinema" concept. The whole system will become operationally interactive and instantaneous regardless of how geographically dispersed the production company and studio facilities are from one another.

The most obvious integration of computers and video into the film industry has been in the area of computer graphics. From the early experiments of John Whitney in the 1960s to such films as *2001*, *Star Wars*, *Looker*, *Alien* and Disney's 1982 summer release, *TRON*, computer imagery has been used primarily as an "effect."[17]

The majority of the computer animated graphics in *TRON* were developed at Mathematic Applications Group Inc. of Elmwood, New York. Affectionately known as MAGI, the group created images based on shapes programmed in Fortran.[18] After the image is rendered in three perspectives on graph paper, the animator begins punching the code into the computer to render "pencil sets," or a computer generated line drawings of the object. Each frame can then be "colored" by programming pixels on a color monitor.[19]

One of the unique aspects of MAGI's operation was their ability to transmit the computer animation via transcontinental modem hookup to the Disney studio's in Burbank; the time saved was approximately two and a half days from the creation of each scene.[20]

Bill Kroyer, one of the chief animators for the picture put it this way: "there was nothing done with the computers on *TRON* that could not have been done with conventional animation given $45 million and 100 years."[21]

Computers are also actively engaged in producing and controlling sound effects. Frank Serafine, in his Lion's Gate studio, mixed organic and synthesized sounds with a computer for *TRON's* sound effects track.[22] In addition, Serafine and his team employed video tape transfers of the workprint with time code so that they could synchronize and mix several complicated sound tracks to the picture without sacrificing audio quality. "Many sounds are . . . assembled by time code and inserted at the chosen point."[23]

Robert Randles, composer and music editor, invented a computerized music editing system called *Musync*.[24] Used on the film *Conan*, Randles uses his system to mathematically chart tempos so that musical beats can be synchronized to specific film frames. Although Randles uses a flatbed editing table interfaced to the computer for his work, the system can be adapted to use a video cassette deck with a SMPTE time code.[25]

For filmmakers, steeped in a photo-mechanical tradition that has remained relatively unchanged for more than eighty years, the technological revolution is a hard pill to swallow.

The development of solid state circuitry and the microchip are destined to convert us from a world of analog signals to digital ones whether we like it or not. Development is underway to

revolutionize the recording industry replacing vinyl records and mylar tape with digital laser discs; the videodisc, which has been around for a few years now, promises to become interfaced to microcomputers for database mass storage and interactive educational instruction.[26]

The advances of the digital revolution could go on for several pages. As we are all constantly being made aware by the mass media, we are involved in a communication explosion that is unparalleled in history. It would only seem natural that filmmakers will trade in their antiquated processes for more versatile, electronic ones which promise a tremendous savings of both time and money.

I believe Francis Ford Coppola is right when he suggests that the high cost of current film production, which is directly related to the amount of time spent in production, has contributed to the vast decline in both the quality and quantity of motion pictures distributed each year. Coppola is also convinced that these computerized video-assisted production techniques, currently under development, will become standard in five years to ten years.[27]

The advances in digital computers, high definition television, and satellite transmission of telecommunications signals will revolutionize the cinema as we know it today. Don't be surprised to find a 6-foot receiving dish sitting atop your local theater aimed at the heavens and waiting for the show to begin.

NOTES

[1] Allen A. Boraiko, "The Chip," *National Geographic,* 162 (October 1982), pp. 421-56. This article covers the historical development of the microchip in addition to current advances by electronics firms primarily located in Silicon Valley. It also covers "chip architecture" (how silicon IC's are made), various applications of the chip, and future integrated circuit designs. This issue contains other computer-related articles.

[2] Gene Youngblood, *Expanded Cinema* (N.Y.: E.P. Dutton & Co., 1970), p. 208.

[3] Youngblood, p. 215.

[4] "Editing Film On Tape: An Interview With Art Schneider," interview in *Educational And Industrial Television,* 14 (February 1982), p. 28. Schneider gives an in-depth discussion on computerized video tape editing. He not only discusses the Film 5 system at CFI, but also other editing systems which range in complexity and application. The second part of this interview appears in the March 1982 issue of *EITV.*

[5] "Editing Film On Tape," p. 28.

[6] "Editing Film On Tape," p. 28.

[7] "Editing Film On Tape: An Interview With Art Schneider--Part 2," interview in *Educational And Industrial Television,* 14 (March 1982), p. 58.

[8] "Computer Assisted Filmmaking: Computer Research and Development at LUCASFILM," *American Cinematographer,* 63 (August 1982), p. 775. The article reports that most of the computer research under development at Sprocket systems has yet to be used with films made at Lucasfilm, Inc. The article mentions, however, that at least one area of research (not identified in the article) was completed and was used on *Revenge of the Jedi,* the next *Star Wars* episode; another branch of the group has done work for one outside production.

[9] "R&D at LUCASFILM," p. 773.

[10] "R&D at LUCASFILM," p. 773.

[11] "R&D at LUCASFILM," p. 773.

[12] "Computer Assisted Filmmaking: Coppola's Electronic Cinema System," *American Cinematographer,* 63 (August 1982), p. 777. Coppola talks at length about his entire operation, his developments and future plans for his "Electronic Cinema" system;

however, because of a patent application pending on one aspect of his system, certain sections of the article were deleted. The "editor's note" indicates that this information will be published in a future issue of *American Cinematographer* when the patent is issued. For additional information about these and other production techniques, see "Mating Film With Video for *One From The Heart*" in *American Cinematographer*, 63 (January 1982), pp. 22ff.

[13] "Coppola's Electronic Cinema System," p. 777.

[14] "Coppola's Electronic Cinema System," p. 777.

[15] "Coppola's Electronic Cinema System," p. 779.

[16] "Coppola's Electronic Cinema System," p. 781.

[17] John P. Mello, Jr., "*TRON: Man in the Computer*," *80 Micro*, 31 (August 1982), p. 126.

[18] Mello, p. 127.

[19] Mello, p. 128.

[20] Mello, p. 128.

[21] "Computer Imagery for *TRON*," *American Cinematographer*, 63 (August 1982), p. 803.

[22] Frank Serafine, "Sound Effects Design and Synthesis for *TRON*," *American Cinematographer*, 63 (August 1982), pp. 807, 830-831.

[23] Serafine, p. 830.

[24] "Computer Assisted Filmmaking: Computerized Music Editing," *American Cinematographer*, 63 (August 1982), pp. 783-786. This article includes a complete description of the editing system and a sample printout by *Musync* for the film *Beyond Reason*. The printout includes musical beats, coded comments, dialogue and a precise "beat list" indicating the exact sprocket the beat falls on. It should be of particular interest to those engaged in any aspect of music.

[25] "Computerized Music Editing," p. 785.

[26] "Interactive Videodiscs," *BYTE*, 7 (June 1982). Almost a whole issue dedicated to various aspects of the videodisc interfaced to the computer. The topics include: learning how to develop interactive videodisc programs, design and production of an interactive videodisc system, videodiscs in education, videodiscs and optical data storage, and the integration of the microcomputer and communication technologies.

[27] "Coppola's Electronic Cinema System," p. 781.